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Issued October 29, 1897.
Reprinted without change, February, 1915.

U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 61.

ASPARAGUS CULTURE.

BY

R. B. HANDY,
DIVISION OF PUBLICATIONS.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1915.

CONTENTS.

	Page.
Introduction	5
History	5
Botany and varieties	6
Production of plants from seed	8
Saving the seed	8
Selection of plants	11
Selection and preparation of soils	12
Planting and cultivation	14
Manuring beds	18
Cost of an asparagus bed	22
Harvesting and marketing	23
Canning and drying	29
Canning	29
Drying	29
Fungus diseases	30
Insect enemies. By F. H. Chittenden	34
The common asparagus beetle	34
The twelve-spotted asparagus beetle	38

ILLUSTRATIONS.

FIG. 1. Asparagus crown, roots, buds, and spear	7
2. Asparagus stem, leaves, flowers, and berries	9
3. Knife for cutting asparagus	24
4. Asparagus buncher and bunch of spears ready to be tied	26
5. Box containing 24 bunches of green asparagus	26
6. Two bunches of green asparagus	27
7. End view of the two bunches of green asparagus shown in fig. 6	27
8. Four bunches of prime white asparagus	28
9. End view of three of the four bunches of prime white asparagus shown in fig. 8	28
10. Stems of asparagus affected with "rust" caused by the fungus <i>Puccinia asparagi</i> DC	30
11. Magnified spores of <i>Puccinia asparagi</i> DC	31
12. Portion of rusted asparagus stems	32
13. The asparagus anthracnose (<i>Colletotrichum</i> sp.)	33
14. Common asparagus beetle	35
15. Spray of asparagus, with common asparagus beetle in its different stages; asparagus top, showing eggs and injury	36
16. Spotted ladybird	37
17. Twelve-spotted asparagus beetle	38

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF PUBLICATIONS,

Washington, D. C., September 30, 1897.

SIR: I have the honor to submit an article on Asparagus Culture, prepared by Mr. R. B. Handy, of this Division. Frequent inquiries for information on this subject led to its preparation. Besides the author's knowledge of the subject, which is considerable, special opportunities have been afforded him for studying the methods of the most experienced and successful growers. The assistance of Mr. L. H. Dewey, of the Division of Botany, was invoked in preparing the matter on the botany of the plant, and that portion of the article relating to fungus diseases has been read and approved by the chief of the Division of Vegetable Physiology and Pathology. The concluding portion relating to insect enemies of the asparagus is the work of Mr. F. H. Chittenden, of the Division of Entomology, who has made a special study of insects injurious to this plant. I have the honor to recommend its publication as No. 61 of the Farmers' Bulletin series.

Respectfully,

Hon. JAMES WILSON,
Secretary.

GEO. WM. HILL, *Chief.*

ASPARAGUS CULTURE.

INTRODUCTION.

The popularity which asparagus has achieved during recent years is remarkable. Formerly a luxury on the tables of the rich, it is now, during the season, a vegetable seen daily upon the tables of people of moderate or even of small incomes. It is also frequently recommended as an article of diet for the sick and convalescent.

The fact that asparagus appears in the market at a time of the year in which few or no other fresh vegetables are available has had much to do with its increased consumption in our cities. It can also be easily preserved by canning, the product in this form being almost equal to the fresh article, and this has increased its use, being as it were a lengthening of the season. Growth is also easily forced out of its regular season, thus making the vegetable available for use from the beginning of December throughout the entire winter and almost until the regular spring season appears, but this product of the gardener's skill is naturally quite expensive. Field culture, too, is one of the most interesting innovations of the present age, and one which has been attended with the most striking success.

Within the last few years the cultivation of asparagus has been greatly extended, yet the demand is still greater than the supply, an indication that there is still room for an extension of beds by those already in the business and for the establishment of beds by those who have as yet given no attention to this branch of gardening. Every kitchen garden should have its bed, from which the table may be supplied with this most delightful and wholesome vegetable, and it is hardly to be doubted that a diffusion of knowledge concerning the later and improved methods of culture, with their reduced* cost and lightened work, would do much to increase the popularity of the vegetable, and bring about its cultivation in gardens where it has never found a place, but where its introduction would add greatly to the present diet of the family.

HISTORY.

The use of asparagus is almost as old as the hills and marshes on which the ancient writers say the two varieties of their day grew. First as a medicinal plant and then as a vegetable it was known to the Romans. Writers of those days praise its virtues with enthusiasm, and the epicure counted it one of the delights of his table. For want

of a better way, the sprouts were preserved by drying, as is done by thrifty farmers' wives to-day to lengthen the natural season. So far had the gardeners of that day progressed in its improvement that Pliny was able to record spears of it weighing three to the pound.

Once made familiar with the use of the native article by the invading Roman soldiery, the Gauls, Germans, and Britons appreciated its value, and it soon became one of their most prized vegetables. Early writers on horticultural subjects leave no room for doubt that as early as the first part of the sixteenth century—four hundred years ago—the use of asparagus was not only general in nearly every part of Europe, but that in some parts its development was such as to put the so-called “colossals” and “mammoth” of the present day upon their mettle, since spears weighing over one-half pound each were not of uncommon occurrence.

In France, Holland, Germany, Hungary, and England asparagus was both gathered by the peasantry in its wild state and carried to the towns for the tables of the prosperous burghers and grown in the landlord's garden for his own table.

The early settlers of America, familiar with its use, brought the seed of the plant with them, and, though not native to this country, it found the climate congenial. John Josselyn, gent., in “New England Varieties,” etc., published in London in 1672, says, in a list of “Plants which have sprung up since the settlers planted and fed cattle in these parts,” that “asparagus thrives exceedingly.”

Although a “cosmopolitan,” there are localities where its skillful culture has produced such results, both as to size of spears and average yield, that they are noted the world over as asparagus-growing centers. Many of the States of the eastern coast, from Charleston, S. C., to Boston, Mass., of the Mississippi Valley, and of the Pacific Slope, produce a great amount of asparagus, but it is in Long Island and New Jersey, owing probably to their proximity to the larger seaboard cities, that much attention has been given to its cultivation, and there its culture has reached a high state of development.

BOTANY AND VARIETIES.^a

The genus *Asparagus* belongs to the Lily-of-the-Valley family. It includes about 100 species, all native in the Old World. A few species, including the familiar asparagus vine and the smilax of the florist, are in common cultivation for ornamental purposes, but most of them, having no recognized economic value, are known only to botanists. All of the various forms and varieties of the vegetable, now in common cultivation under the name of asparagus and sold in the markets as “grass,” have been derived from one species, *Asparagus officinalis*.

^aThe first paragraph under this heading was prepared by Lyster H. Dewey, an assistant in the Division of Botany, United States Department of Agriculture.

This is a branching, herbaceous plant, growing to a height of 3 to 7 feet from perennial rootstocks. The rootstock or "crown" makes a new growth each year of from 1 to 3 inches, extending horizontally and generally in a nearly straight line. It may propagate from both ends or from only one, but in either case the older part of the rootstock becomes unproductive and finally dies. The upper side of the new portion of the rootstock (fig. 1) is crowned with buds for the production of new shoots, while the older portion bears the scars and dead scales of previous growths. From the sides and lower surface of the rootstock numerous storage roots extend almost horizontally to a distance of 1 to 3 feet. They are light colored and from one-eighth to one-fourth inch in diameter. They often form a complete underground network in old beds, making it impossible to plow or cultivate deeply. These storage roots bear numerous small feeding roots, especially on the newest parts of their growth; hence they fulfill the office of principal roots, but they have in addition the special function of storing nourishment for the growth of the following season.

Although but one species of asparagus is to be found in cultivation there are many so-called varieties. Thus we have Colossal, Barr's Mammoth, Columbian Mammoth White, Donald's Elmira, Palmetto, etc., in our own country, besides the numerous "varieties" cultivated in France, Austria, Germany, England, etc., when in reality there are probably but three or four of them all which deserve to have special names, being nearly all susceptible of classification under the general head of "Giant," or "Mammoth," indicative of the improved size produced by the superior conditions of manuring, soil, climate, and cultivation to which they have been subjected.

Brinckmeier and Göschke speak of four cultural varieties which have such distinct individual characteristics, and whose seed reproduce these in the plant, as to entitle them to special notice: The German Giant—in which the Holland, English, and most of the French and American kinds are embraced—the Early Argenteuil, Conover's Colossal, and the Yellow Burgundy.

Through natural and artificial selection, through use of seed from strong shoots from superior roots, there has been improvement in the size and yield of asparagus; from the peculiar adaptability of soil and climate and the effect of manure and high cultivation there have



FIG. 1.—Asparagus crown, roots, buds, and spear. (Redrawn and reduced; from plate 113 of Thomé's *Flora von Deutschland*.)

appeared certain variations in the product of different beds which have led to the bestowing of a new name; but the effect of this care and these favorable conditions is not sufficiently strong to produce distinct varieties with fixed characteristics. Generally these "varieties" differ only in a single characteristic, and these differences, for the most part, are so little constant that they are lost when grown under different climatic and soil conditions. Therefore, with correct and rational treatment of the plant from time of seeding through all the stages of culture, satisfactory results may be reached with almost any of the varieties on the market.

PRODUCTION OF PLANTS FROM SEED.

To the asparagus grower there are two methods by which plants can be secured, (1) by purchasing or saving the seed from which to raise them, and (2) by purchasing the plants from either a seedsman or some grower. Taking the second method, as being the quickest way to start a bed as well as the most easily disposed of, it is suggested that roots over 2 years old be rejected, and only 1-year old roots selected if a sufficient number can be secured, as the latter are much better and will in the course of a few years produce more and larger spears to the plant and yield profitable crops for a longer period. It is best to deal with reliable firms; they will be more likely to supply plants of both the kind and age desired. It is extremely difficult for anyone not an expert to distinguish the difference between the various sorts, and doubtless many "varieties" are often supplied from the same lot of roots; nor is it easy to tell the difference between a strong, well-grown 1-year plant and a small and stunted 2-year old (the left over of last year's supply) left unmanured, uncultivated the second season, that the development might be retarded.

SAVING THE SEED.

For the above reasons only reliable seedsmen should be trusted, or the seed should be procured from some neighbor who has the desired variety and has taken proper care in producing and saving the seed, if the first plan is to be followed. If one already has an asparagus bed of the desired sort, producing fine spears, and of the proper age (8 to 12 years old) for seed production, it is always best to save seed from it for new plantings.

The growing of one's own plants is preferable, both because of the extra year intervening between the determination to plant and the actual setting out of the bed, thereby permitting the soil of the proposed bed to be put in a better and more friable condition, and because, good seed having been secured and proper care given to the young plants, a more satisfactory supply of the young roots is obtained.

That there are objections to growing one's own seed is undoubtedly true, but there are also compensating advantages, and if proper care is exercised it will pay the grower to raise his own seed (from beds

which are satisfactory) even if seed can be bought in the open market for much less than the trouble of attending to the home grown may cost. If, however, a grower is unwilling or unable to exercise the necessary care in the production of seed, he would do much better not to attempt it, but depend upon some reliable dealer, studiously avoiding those whose claims to patronage are based upon cheapness of stock. Good seed are worth good money; poor seed should not be accepted under any conditions.

Since asparagus is propagated only from seed, the natural tendency to atavism and resistance to constancy and reproduction in form makes difficult the maintenance of a certain combination of desirable qualities in any variety. Therefore, even if the seed are secured from a bed which has distinguished itself for a large yield of fine spears, a new bed with like qualities is by no means insured. A careful selection should be made of seed-bearing shoots (fig. 2) possessing the desired characteristics, the seed should be fully developed before they are gathered, the young plants should receive the best attention, and both in planting and future attention the bed should receive thorough and rational treatment. If these are neglected it is not to be expected that the bed will be a success.

Any observant grower will become aware of two facts connected with his bed, (1) some clumps each year produce larger, earlier, and finer spears than others, and (2) some stalks bear seed while others do not. In connection with these it is ordinarily found to be true that the clumps producing nonseed-bearing stalks bear the largest spears.

During the spring cutting of the year preceding that in which the seed are to be saved, the clumps producing the largest, finest, and earliest spears should be marked, selecting four or five seed-bearing to one producing nonseed-bearing stalks; these should be as close together as possible, or in bunches, that the pollen may not fail to be effective. When spring comes, one or two of the largest and earliest stalks of each of the hills should be permitted to grow, cutting the later-appearing spears just as is done with the other spears for market. Thus these early stalks of both male and female plants will bloom together before



FIG. 2.—Asparagus stem, leaves, flowers, and berries. (Redrawn and reduced; from plate 113 of Thomé's Flora von Deutschland.)

any other stalks, and the blooms on the female plants will be fertilized with the pollen of the selected male plants. This is of importance, for on proper fertilization depends the purity of the seed as well as the vigor of the resultant plants.

Not all seed of even a good plant properly fertilized should be used for reproduction, as of the seed gathered from any plant some will be better than others. Only the largest, plumpest, best-matured seed should be used, for by saving these the most nearly typical plants of the sort will be more certainly produced. The selection of the best seed from typical plants is as essential to success as are good soil, thorough cultivation, and heavy manuring.

The best seed are produced from the lower part of the stalk, hence it is well to top the plant after the seed are well set, taking off about 10 inches, and to remove the berries from the upper branches, that all the strength may go to the full development of the more desirable berries. If, after this has been done, there is more than sufficient seed for the purpose desired, a second discrimination can be made between the seed of plants which produce numerous berries and those which are shy bearers, the latter being desirable, as this indicates a tendency in the plant to produce stalk rather than fruit, and it is as a stalk producer that asparagus is valuable.

Harvesting, cleaning, and preserving the seed is, of course, to be done carefully; the separation of the heavy and light seed can be accomplished by means of water, while the larger can be selected from the resultant mass by the use of a properly meshed sieve.

When the berries are scarlet red and fully ripe, the entire plant is cut near the ground and put away where it is free from rain or dampness, and safe from the attack of birds or from other damage.

When there is somewhat more leisure, the berries are stripped off, soaked in water for thirty-six or forty-eight hours to soften the skin and pulp of the berry, and then rubbed between the hands until the black seed are freed entirely from the pulp. Spread and dry and put away in a paper or linen bag until needed. It is not wise to use seed over 2 years old, although they will retain some vitality for several years.

Fresh seed may be distinguished by the uniform smooth surface and the brilliantly black scale; the old seed have a smutty, gray color, and the surface is much roughened and wrinkled. One pound of seed will produce about 3,000 sprouts, and should be sown in a light, rich, sandy soil in rows about 15 inches apart and $1\frac{1}{2}$ inches deep; so thinly should the seed be sown that the plants will not stand closer than $1\frac{1}{2}$ or 2 inches, and these should afterwards be thinned by hand to about 3 inches apart, care being taken to leave the strongest and most thrifty shoots.

Careful weeding and hoeing are needed throughout the growing season, and in dry weather irrigation will greatly increase their growth.

Watering between the rows with liquid manure is of great assistance to the young plants, which with the care indicated above should bring large thrifty plants ready for setting out in the beds early the next spring.

SELECTION OF PLANTS.

Much depends upon the selection of plants. A good strong "crown" with few but well-developed buds and plenty of roots is essential to the production of large and thrifty spears. A "crown" with numerous buds, or eyes, will be more than likely to produce numerous but small spears, and afford a total yield much less than the other kind.

As has been previously stated, 1-year-old crowns are to be preferred, as it has been proved that in the course of years the 1-year-old will produce larger and more valuable crops than either 2 or 3 year olds, although this was not formerly the opinion of growers. Small 1-year crowns, while not as desirable as large ones of the same age, are preferable to larger crowns 2 years old, and at the end of a year or two will be as large, more vigorous, and more productive. For instance, Lebeuf, who planted twelve crowns each of 1, 2, and 3 years of age, found at the end of the third year of identical treatment, in the same soil, the yield was as follows:

	Pounds.
One year old.....	7
Two years old.....	3 $\frac{3}{4}$
Three years old.....	2 $\frac{1}{2}$

The 1-year-old plants at the end of three years yielded almost twice as much as the 2-year-old and nearly three times as much as the 3-year-old crowns.

There is something also to be said in favor of selecting plants which bear only staminate flowers, for, as these do not produce seed, the strength which would be taken to mature the seed goes to the storage of nourishment in the roots, thus enabling them to produce larger, earlier, and better spears for the next spring's cutting.

Prof. W. J. Green, in a Bulletin of the Ohio Agricultural Experiment Station (Vol. III, No. 9, second series, 1890), reports observations on this point. In order to determine the difference in vigor between the seed-bearing and nonseed-bearing plants, fifty of each were staked off, and when cutting commenced the spears taken from each kind were kept separate and the weight of each recorded, with the following result:

Period of growth.	Product from fifty male plants.	Product from fifty female plants.
	Ounces.	Ounces.
First period of ten days.....	37	21
Second period of ten days.....	104	68
Third period of ten days.....	266	164
Fourth period of ten days.....	203	154
Total for season.....	610	407

This shows a gain of male over female plants of 76 per cent for the first period and a fraction less than 50 per cent for the whole season. There was a still further difference in regard to quality; the spears of the male roots, being earlier, larger, and finer, had also a higher market value. It is not safe to draw definite conclusions from this one experiment, but the experience of many growers corroborates these results. Male plants can be secured by selecting roots whose stalks have borne no seed. This can often be decided with large well-grown yearling plants, and when two years old, the presence or absence of seed will be an indication of the sex of the plant, and it might be profitable to use 2-year-old plants, if only male plants are selected, because of the probable increased yield of large early spears.

SELECTION AND PREPARATION OF SOILS.

Selection comes before preparation and is equally important. Although a bad selection may be counteracted by methods of preparation, just as improper preparation may be corrected by means of cultivation, both efforts at amelioration are extremely costly.

Asparagus will grow on most soils, and will yield large crops upon stiff soils; but for the purpose of the grower for market, a light sandy soil of fair fertility is much to be preferred, both because of the earliness with which it produces marketable spears and the ease with which it is cultivated.

A soil on which water stands after rain, or under which the standing subsurface water is near the surface, into which the roots are liable to penetrate, is to be avoided. Of course, such a soil, if otherwise suitable, can be made fit by a thorough system of underdrainage, since an occasional overflow, or even a submergence of the beds for several days, is not necessarily injurious if the drainage, either natural or artificial, is good. There are instances where established beds have been under water for a lengthy period during heavy spring rains or very high water and were not injured. Göschke, in his book on *Asparagus Culture*, relates two instances, one in Germany at Merseburg on the banks of the Saale, where for six weeks in early spring the water covered the beds; and the other at Everly, some 75 miles east of Paris, where water stood many weeks during the winter upon large stretches of asparagus land, yet in both instances the succeeding crops were both early and large—better, in fact, than on land which had not been overflowed. Of course, the soil was light and porous, never becoming baked, and the natural drainage was good.

The soil should be free of roots, stones, or any trash that will not readily disintegrate or that will interfere with the growth of the spears. Yet the writer knows a rather stiff but naturally well-drained soil which produces early and fine asparagus, notwithstanding the fact that it is full of large gravel, some of the stones being twice the size of a man's fist.

Fruit or other trees or high shrubs must not be allowed in the asparagus bed, because of the shade they throw over the beds and because their roots make heavy drafts upon the soil. Nor should high trees, hedges, hills, or buildings be so near as to throw a shadow upon the beds, because all the sunshine obtainable is needed to bring the spears quickly to the surface.

The land should be protected from the north or east (or from the direction of the prevalent winds) and so slope that the full benefit of the sunshine will be obtained during the whole day. Brinckmeier, in his "*Braunschweiger Spargelbuch*," gives the following three rules for guidance in selecting a location for asparagus beds:

(1) One should choose, in reference to ground characteristics, open, free-lying land, protected to the north and east, of gradual slope, free from trees or shrubbery.

(2) The field should be exposed to the rays of the sun all day long; therefore a southern exposure is desirable, or, if that is not obtainable, a southwesterly or southeasterly slope, because either east, west, or north exposure will cause shadows during a greater or less portion of the day.

(3) Standing, stagnant groundwater, which can not be drawn off by drainage, is to be avoided, the requirements of the plants indicating a somewhat damp subsoil, but not too high groundwater.

From the above it is deduced, and experience corroborates the theory, that a not too porous, but a well-drained, light, deep, sandy loam, with a clay subsoil, is to be preferred to all others.

Freedom from weeds is very desirable, even more so than great fertility, for the latter can be produced by the heavy manuring which the future cultivation will require; and to the end that weeds may be few, it is well that for a year or two previous to planting the land should have been occupied by some hoed crop, such as potatoes, beets, cabbages, etc.

In the late fall or early winter the selected area, should it be a light sandy loam as described above, needs to be deeply plowed, and if the subsoil is not already of an open and porous nature, through which surface water will readily drain and the roots easily penetrate, a subsoil plow should follow, breaking the soil to the depth of at least 15 inches. After harrowing the field, a good compost of well-rotted horse, cow, sheep, or other manure should be spread broadcast and left to the action of the weather until as early in the spring as the ground is in condition to be worked, when the manure should be plowed in, the surface carefully harrowed, and the soil put in a light and friable condition.

Formerly it was customary to trench the whole field, and in case the soil was too binding and stiff, to mix in sand, etc., in order to ameliorate its condition. In fact such practice is still commonly followed among the intensive growers in the thickly populated countries of Europe. But trenching is very expensive, and it has been proved to be unnecessary, and in some soils, where, for instance, the soil was sand with but little humus, the placing of the better soil below, with the unfertile sand above, is a positive detriment.

PLANTING AND CULTIVATION.

Spring is the best time to plant, but planting is often extended or delayed until the last of June, and in some more southern sections it is done in the autumn. In this bulletin the subject is treated from the standpoint of spring planting. It is perhaps because of the fact that most of the work of preparation can be done in the pleasant fall weather, and because of the beneficial effect of the frost, snow, and winter rains upon the freshly plowed land, that spring planting is preferred; but there are also some advantages which attend the planting itself that are of importance. In the spring the roots bear transplanting with less injury than later in the year, and the early spring rains insure against the necessity of watering the plants, which would have to be done at the midsummer season. In the fall planting, it depends too much upon the following winter whether the roots would not be winterkilled.

As early in the spring as the condition of the ground will permit work to be done—when it is dry enough to bear plowing and the soil will break up fine—rows should be marked off 4 to 6 feet apart and opened up with a large plow, going a sufficient number of times to make a furrow from 8 to 12 inches deep. Loose soil that the plow does not throw up should be taken up with a shovel or wide-bladed hoe. It is in these furrows that the crowns are to be set, the distance to be left between plants varying, according to the opinion of the grower, from 18 inches to 5 feet.

The question of distance between rows, and between plants in the row, is one about which there are many diverse opinions, each grower defending his adopted space, either upon his idea of the needs of the plant or the purpose he has in view. For example, three men from different sections, each of whom is a successful and intelligent grower, writing to the author on this subject, differ widely on this point. The first has a sandy loam, naturally well drained; he says, "rows should be 6 feet apart, plants 4 feet distant down the row and 12 inches deep." The second, with a loamy clay soil, suggests as the best arrangement "4 feet between the rows, 18 inches in the row between plants, and from 4 to 6 inches deep." The third, with a light sandy soil, "prefers rows 5 feet apart, plants 2½ feet from each other in the row, and crowns 6 inches below the level of the soil." Of three German authorities, Göschke recommends 52 inches between rows and 40 inches between the plants in the row, and a few inches deep; Binz describes the proper distance to be 47 inches by 39 inches and the rows 8 inches deep; Brinckmeier will not agree at all to the advantage of the single-row bed, maintaining that the double-row bed is equally advantageous for the growth of the plants, and much better for the grower, as the yield is larger.

Lebœuf, a French authority, says:

When planted in an open plat, the shoots should be 3½ feet from each other, but if two are grown side by side (double rows) they should be 2½ feet apart. For our own beds we have adopted a uniform distance of 4 feet between the lines, the plants

being $3\frac{1}{4}$ feet apart. Whatever may be the distance, the weight of the crop is about the same if the crops be kept properly apart, but crowded asparagus beds produce late and smaller crops of very inferior appearance and quality.

Of course inferiority means a low price per bunch. Besides, the beds will not continue profitable so long if too closely planted. They are more liable to attacks from insects and disease, require more manure, and are more difficult to cultivate. It would seem that the advantages resulting from plenty of room are a full compensation for the extra ground occupied.

The depth to which roots should be planted is somewhat dependent upon the soil and somewhat upon the method of cultivation and the kind of produce desired.

It is reasoned by those in favor of deep planting that as the crown is built anew every season a fraction of an inch above the old one, and a bed is expected to live and produce profitably for from twelve to twenty years, room should be allowed for the new growths before the new crown will reach the surface of the soil; otherwise it will be necessary to raise the entire surface by addition of soil. Elevating the surface is expensive, but the crowns will be injured by cultivation if they are allowed to come too close to the surface, and so, unless planted deep originally, will require to be covered by raising the surface of the soil.

It is admitted that deep planting makes late sprouting during the first few years, yet that is of small matter until the crowns are old enough to bear having the shoots cut; and besides, by "opening up the rows," i. e., throwing up ridges between the rows each spring, the roots will get the heat from the sun, and the soil can be gradually worked back upon the rows after the action of the sun's rays has started the young growth and before the shoots reach the top. The whole surface can be left level, if green asparagus is to be cut, or be ridged, if white asparagus is desired.

On the other hand, equally strong arguments and equally good results are presented by the advocates of shallow planting.

Rows should be run north and south, so that the full benefit of the sunshine will be secured. If the rows run east and west, they will be shaded by the ridges in early spring, when the sun is low in the south, and later in the season they will be completely shaded on one side by the tall foliage. This delays sprouting in the spring, and prevents the best development of the plants at all times. Of course, any conditions, such as the slope of the land, etc., which make it inadvisable to run the rows north and south must be considered, but southeast to northwest or northeast to southwest is better than due east or west, or, in short, the natural conditions permitting, the course should be as far from east and west as possible. This is especially important to those who ridge the rows to produce white asparagus.

When one recalls the care and exactness with which asparagus roots

were set out a few decades ago, or reads the explicit directions given by all European writers, the methods used by many of even our best market gardeners of to-day do not appear to come up to the correct standard of culture. Inquiries among asparagus growers go to show that beyond seeing that the crowns are right side up and the distances approximately maintained, but little attention is paid to placing them. Yet considering the advantages which accrue from a good stand, i. e., having all of the same age, thus preventing the different treatment which clumps of varying ages will for the first few years require, as well as the trouble of replanting and the loss of a year's cutting, almost any pains taken to plant correctly would be time, trouble, and money saved. It is in fact very little trouble to spread the roots evenly in the bottom of the furrow; or even to form a small hill in the bottom, over which to place the roots with the crown resting on the top, does not require any great amount of time over and above that required to place the roots haphazard in the row.

The former plan of putting manure in the bottom of the row before planting, as well as that of loosening the soil at the bottom so that the roots will find an open soil, have been abandoned, the former because top dressing and mulching has proved superior, and the other because it has been found that asparagus roots are mostly lateral, some even growing upward from deeply planted crowns, and that those which grow downward thrive best in a more compact stratum. The crowns should be promptly covered with about 3 inches of friable soil, and this is readily done by a 1-horse plow (the moldboard having been removed) being passed down the side of the rows. This leaves the plant in a depression, the soil thrown out in opening the rows forming a ridge on each side. This depression will gradually become filled during the process of cultivation during the succeeding summer.

Careful weeding and loosening of the soil at frequent intervals during the growing season is necessary to keep down the weeds and grass, and to preserve a mulch of loose soil to retain the moisture and avoid having to water the young plants.

It is the practice of some growers to stake each plant with a stout stick or stave, to which the stalks are tied as soon as they are 18 inches high, in order that the winds may not disturb the roots and thus injure the vitality of the plants; for, as they grow to the height of 30 to 60 inches, presenting a leafy top to the winds, they are easily shaken backward and forward to the detriment of their roots. In large beds this is not done because of the cost, and an effort is made to support the stalks by throwing a furrow to each side.

In the fall when the tops are mature, they should be cut, hauled off, and burned; and part of the soil over the crowns should be removed, so that not over two or three inches remain, that the frost may penetrate and loosen the soil and the rains improve it. This is the reverse of the former practice, when the rows were covered with manure for fear

the action of the frosts should kill the plants. This fear has been allayed. Asparagus roots will never be hurt by frost as long as the crown is covered with a layer of soil 2 inches deep. (Lebœuf.)

Early in the spring of each year, after the plants are old enough to cut, there must be a ridge made over the rows to blanch the shoots, if white asparagus is to be cut; and once ridging is not sufficient, but after the spears begin to appear the ridges will need renewing every week or ten days during the cutting season, as the rains beat them down and the sun bakes a crust upon the top.

With a 1-horse cultivator go between the rows, and then with a 2-horse disk wheel cultivator with two disks on each side go astride each row, throwing up fresh soil upon the ridge. A 12-inch disk on the inside next the ridge, with a 20-inch one on the outside, makes a very effective implement, especially for rather stiff land; but a homemade ridger, formed of two heavy oak boards shod with tire iron, sloping upward and backward, attached to a pair of cultivator wheels, works very successfully in the light sandy soil of eastern Long Island. Some growers leave these ridges undisturbed until late fall and even early spring, but it is better practice to plow them down and run a harrow in both directions crosswise over the field immediately after ceasing to cut and before the tops are allowed to develop. At this time an application of well-rotted stable manure, bone and potash, or liquid manure is in order.

The grower of green asparagus has about the same work, less the ridging and plowing down. As it is necessary to keep down all weeds, some hoeing may be necessary as supplementary to a free use of the 1-horse cultivator. After the cutting season, a cut-away harrow run twice diagonally across the rows loosens up the soil and destroys a vast number of weeds without injury to the crowns, although some spears may be broken off.

Soon after the tops are allowed to develop they become bushy enough to shade the ground and prevent the growth of weeds; so little work will be required, if the weeds have been pretty well killed by the harrowing suggested above, until the end of the growing season.

The bushes should be cut as soon as the berries are fully colored, as the growth will be sufficiently matured so that no injury will be done the roots by removing the tops, thus avoiding a further drain upon the roots to mature the seed, and preventing the dropping of seed, followed by the springing up of innumerable young asparagus plants.

All brush should be promptly collected and burned, that there may be no lodging places for insects and diseases. In case the fields were not leveled, harrowed, and manured at the close of the cutting season, now is a convenient time to perform this work, although if the soil is rather too moist it is well to leave the surface firm, that the winter rains may run off rather than penetrate to the already too damp subsoil around the roots.

MANURING BEDS.

In nothing relating to asparagus has there been a greater change than in the practice of manuring. Formerly it was thought necessary to place large quantities of manure in the bottom of the deep trenches in which the young plants were set out "in order that sufficient fertility might be present for several years for the roots, as after the plants were once planted there would be no further opportunity to apply the manure in such an advantageous place;" it was also considered necessary to use much manure every autumn to bank the beds in order that the crowns should not be injured by the winter's frost. These applications, especially that given prior to planting the young crowns, made the outlay so great, and that for so many years before any return would be received from the bed, that only small plantings were possible to those who were without considerable capital.

Although asparagus is still heavily manured, the amount now used is much less than was formerly supposed to be necessary, only about double the quantity ordinarily used upon root crops, such as potatoes, beets, etc.

It is not a good practice to put manure in the bottom of the trenches or furrows when setting out the crowns, because it is demonstrated to be rather a waste of manure than otherwise, and besides the roots of asparagus thrive better when resting upon a more compact soil; nor is it necessary that the soil should contain great amounts of humus or be in an extremely fertile condition when the plants are first put out, since by the present system of top dressing a moderately fertile soil soon becomes exceedingly rich and equal to the demands which the plants make upon it.

Considerable improvement is produced in the mechanical condition of the soil by the use of stable manure upon beds. By the addition of humus, porous sandy soil is made somewhat more binding and its ability to take up and retain moisture thereby increased; while, on the other hand, cold, heavy soils are made warmer and more porous. Lierke, in his work on Orchard and Garden Culture, says: "On 'raw' ground it is necessary during the first years to give heavy applications of stable manure, but later, when there is an amelioration in the condition, this may be omitted." In another place he remarks: "If one has but a limited amount of manure, it is best to properly manure only a portion of the field each year, and arrange so that each portion may be so treated every two or three years."

All organic manures are suitable for use on the beds; but care must be exercised in the use of any of these lest they be too hot and injure the plants, especially if applied directly to the roots and immediately over the crowns. Where the young shoots come up through it, fresh, hot manure is likely to produce rust or to render the shoots unsightly and thus injure their sale. Especially is this true in light, sandy soils.

The practice of adding to such manurial materials of the farm as stable manure, vegetable compost, etc., single commercial manurial substances that will enrich them in the direction desirable for the particular crop to be raised does not yet receive that degree of general attention which it deserves. In the case of asparagus, an addition of potash in the form of muriate or sulphate of potash, or of phosphoric acid in the form of fine ground South Carolina or Florida soft phosphate, etc., will in many instances not only improve their general fitness as complete manure, but quite frequently permit a material reduction in the amount of barnyard manure ordinarily considered sufficient to secure satisfactory results.

An average of several analyses of barnyard manure.

Constituents.	Percent.	Pounds per ton.
Moisture	67.00	1,340.0
Nitrogen52	10.4
Potassium oxide56	11.2
Phosphoric acid39	7.8

The average barnyard manure contains a larger percentage of nitrogen, as compared with its potash and phosphoric acid, than is generally considered economical. An addition of from 30 to 40 pounds of muriate of potash and of 100 pounds of fine ground natural phosphates (soft Florida or South Carolina floats) per ton of barnyard manure would greatly increase its value as an efficient and economical fertilizer.

Judging by the amount used and by the expressed preference of growers, stable manure free from straw or other long bedding is the most desirable for use upon beds. Besides stable manure, farmyard, sheep, hogpen, and henhouse manure, and night soil are also available when used in compost; and if the compost has been lying long enough to have caused the materials to be reduced to a uniform, well-mixed mass there is nothing better for use at the time of transplanting to cover the young plants.

In addition to these farm manures, chemical or commercial fertilizers are also available and are used alone, in connection with stable manure, and in alternation with the same. Of late years these are being more and more used by growers who are without a large number of farm animals and so far removed from large cities that they find stable manure too expensive, especially as the only advantage of stable manure over these is the humus it adds to the soil and its beneficial effect upon the mechanical condition of the soil, as already explained.

The New Jersey Agricultural Experiment Stations, in planting a trial bed of asparagus, used, "April 11, 400 pounds per acre of a mixture containing 150 pounds nitrate of soda, 400 pounds ground bone, 250 pounds bone black, and 200 pounds of potash, and on May 8 another application of 600 pounds per acre of the same mixture, thus supplying in all 41 pounds nitrogen, 100 pounds potash, and 120 pounds phos-

phoric acid per acre. The following year the same amounts were repeated. The bed was on a sandy loam of good, natural drainage and well adapted to the growth of asparagus."

At the same place experiments were started in 1896 on four plats. Plat 1 received 18 tons per acre of stable manure; plat 2 received 650 pounds per acre of general fertilizer at planting; plat 3 received 650 pounds per acre of general fertilizer at planting and 150 pounds ground bone and 150 pounds muriate of potash November 2; plat 4 received 650 pounds general fertilizer at planting, 200 pounds nitrate of soda July 22, and 150 pounds ground bone and 150 pounds muriate of potash November 2. Of course these are trial amounts, but they ought to suggest the manuring needed, and will, when the experiment is concluded, add to the present knowledge on the subject.

An experienced and well-known New Jersey grower of asparagus, whose farm has a light sandy soil, writes of manuring as follows:

At planting use a good fertilizer in the row. Early in the spring of the second year make a furrow with a 1-horse plow down the row on top of the asparagus and give a good dressing of composted stable manure. Plow on a furrow from each side, making a ridge, which is left until nearly time for asparagus to appear, when it is leveled off with a 2-horse harrow, or, perhaps better, put 3 by 4 inch scantling under the harrow, and level off, making a flat bed. This is repeated each year until the asparagus crowns get too near the surface, and then a furrow is run down each side of the row, and filled with manure, the ridge left between the two furrows being cut down by a cultivator.

Another grower of green asparagus in the same general section, whose beds are great producers, and whose "grass" commands a top price in the markets of Boston and New York, has never used a pound of manure on his asparagus, depending entirely upon chemical or commercial fertilizers.

A Virginia grower, whose farm is a sandy loam, and whose asparagus (green) sold at top prices for "Southern grass" during the season of 1897, writes on the subject of manuring as follows:

The soil should be rich to start with, and kept so. The first spring, at time of planting, I sow in row, after having covered roots about 2 inches deep, 500 pounds raw bone and cover same with about 1 inch of soil. The next spring I sow 500 pounds raw bone broadcast per acre and harrow in, but 1,000 pounds would be better. Every third year a heavy dressing (25 tons) of fine well-rotted manure should be broadcast and well worked in with cutaway harrow in addition to the 500 pounds of raw bone, and every third year 500 pounds of kainit should be broadcast per acre.

Nitrate of soda and sulphate of potash mixed with wood ashes applied in two doses (March and May) keep the asparagus beds going and produce a large yield of fine spears.

Sulphate of ammonia (one part) and muriate of potash (two parts) applied in three doses (March, May, and after the cutting season is over) has been found to be a mixture which proved a very profitable fertilizer for asparagus.

The use of a light dressing of fish manure several times during the season is recommended, as this fertilizer is excellent and cheap.

The application of liquid manure during the early growing season is of undoubted benefit, and the addition of potash and phosphoric acid to the stable manure will make the latter much more valuable and bring its proportions nearer to those of a complete fertilizer.

When potash salts (kainit or muriate) are used, the application of salt will be superfluous, even if it is ever necessary. On clayey soils salt is always dangerous, causing the soils to run badly and become pasty, while its benefits, except as a weed destroyer, are of a doubtful character.

The time of applying manure on beds, and the position where it should be placed, are of some importance. In the use of stable manure, both writers upon the subject and growers actually engaged in producing asparagus for the market almost unanimously state that "in the autumn, after the stalks have matured and have been cut, manure should be applied on top of the rows." Some give the caution not to put it just over the crowns, lest the shoots next spring be injured by contact with it.

This plan of top dressing beds during the autumn or early winter is gradually giving way to the more rational mode of top dressing in the spring and summer. It was believed that autumn dressing strengthened the roots and enabled them to throw up stronger shoots during the following spring. This is a mistake.

It is during the growth of the stalks after the cutting season is over that the crowns form the buds from which the spears of next season spring, and it is probable that it is principally during this period that the roots assimilate and store up the material which produce these spears. This being true, the plant food added to the soil and becoming available after the cessation of vegetation in the autumn can have little, if any, effect upon the spears which are cut for market the following spring; it first becomes of use to the plant after the crop has been cut and the stalks are allowed to grow. Thus the manuring of the autumn of 1897 will not benefit the grower until the spring of 1899. In the use of hot, or fresh, manure it may be that the winter season is none too long to permit the fertilizing elements to become available and well distributed throughout the soil, but if well-rotted manure is used there is danger of the fertility being leached out of the soils by the rains and melted snows of winter.

The writer suggests feeding when the roots can absorb the manure instead of placing a large quantity of it over them after the growing season, when the plant is at rest. Those growers who apply a liberal dressing of stable manure or fertilizer immediately after the cutting season supply the required nourishment to the plants at the time they most need it and can most profitably utilize it in the production of spears. Manure thus applied will also act as a mulch, preventing the

growth of weeds, keeping the soil light and cool, and preserving the moisture intact. It should not be made on top of the row. This suggestion the writer wishes to emphasize.

Manuring in November in many cases does more harm than good, as the mass of manure causes many roots to decay, and those which do survive are weak and only produce small spears. It would be much better to rely upon liberal supplies of food through the growing season than to give manure when the bushes are cut, as at the former period the roots can more readily absorb the food given. By feeding in spring and summer the crowns are built up for the next season's supply of grass. The roots of the asparagus are perhaps always active, but much less so in winter than at any other season, and they will obtain as much nutriment from the soil as they can then use. If heavily covered with manure sunshine is excluded, growth is checked, and the roots have to fight hard for existence at a time when they are none too strong.

In the culture of green spears the manure is best utilized by broadcasting, this application to be followed by a thorough harrowing of the field. When white asparagus has been cut, either manuring in the trench between the ridges before disturbing them or harrowing down the ridges and then manuring broadcast is perhaps the most rational way.

As between manuring in the row and between the rows, the latter should be selected as the evidently advisable one by which the feeding roots of the plants are most easily reached. Placing the manure in the row only reaches those feeding roots which are to be found about midway between the crowns, as just around the crowns are nothing but storage roots, besides it is not desirable to place manure too close to the crowns; but manuring between the rows puts the manure right where the summer rains can carry the fertility directly down into the (as it were) open mouths of the feeding roots.

COST OF AN ASPARAGUS BED.

The cost of establishing and maintaining an asparagus bed is so dependent upon the value of land, the cost of labor, the kind and amount of manure used, and the method of securing plants, etc., that no definite figures can be given, but can be best estimated by the farmer himself, remembering that it is only once in fifteen or twenty years that this has to be met.

A prominent and successful New Jersey grower says:

I can not give the cost in detail of establishing asparagus beds, as so much would depend upon whether one had roots to buy, and upon other matters. Where growers usually grow roots for their own planting the cost is principally the labor, manure, and loss of use of land for two years, upon which, however, a half crop can be had.

The cost of maintaining a bed I can only estimate, as at times all the men on the farm may be at work at the asparagus, and at other times none at all, and I do not

keep an account of the time put in at the asparagus. I should estimate the cost per acre as follows:

Manure (applied in the spring)	\$25.00
Fertilizer (applied after cutting)	15.00
Labor, plowing, cultivating, hoeing, etc.....	20.00
Cutting and bunching	40.00
Total	100.00

A bed well established, say five years after planting, when well cared for should for the next ten or fifteen years yield from 1,800 to 2,000 bunches per annum, or at 10 cents per bunch (factory price), \$180 or \$200.

This agrees very closely with the actual figures of the yield and receipts of another New Jersey grower who in 1896 cut 22,584 bunches from 12 acres, all of which were not in full bearing, or 1,882 bunches per acre, and received \$2,611 net returns from commission houses, or a fraction over 11 cents per bunch. Of course those getting higher prices or larger yields will exceed this, but it is a fair average for those who sell on commission or to canneries.

The cost of good 1-year-old plants ought not to be over \$4 per thousand, and it requires from 1,800 to 3,600 to fill an acre, depending upon the distance between plants; perhaps 2,500 would be a fair number, allowing surplus plants to fill missing hills, or \$10 per acre. The plants can be grown from the seed for half that sum, if that plan be preferred.

The cost of establishing a bed can be somewhat reduced by planting for the first two or three years some early garden crop between the rows, such as potatoes, peas, beets, onions, strawberries, etc., for as the roots are as yet not occupying all the ground there will be no injury to the plants, and the manure and cultivation necessary for the young asparagus will be sufficient for the other crop, hence the receipts for it will be almost entirely net, and yield at least the returns of "a half crop."

The estimate above calls for an annual expenditure of \$40 per acre for fertilizer and manure, which is a liberal allowance; another estimate requires 2,000 pounds per acre of a mixture containing 400 pounds of muriate of potash, 1,100 pounds acid phosphate, and 500 pounds of nitrate of soda, which at market prices can be secured for less than the above sum.

HARVESTING AND MARKETING.

Asparagus is one of the earliest vegetables, especially if the roots are near to the surface or the soil above them has been temporarily removed so that the rays of the sun can easily penetrate to them. Some varieties are earlier than others, and this difference in time of appearance varies from a day or two to several weeks. For instance, the Early Argenteuil is about ten days earlier than the ordinary asparagus grown in the same locality, and the Late Argenteuil at least ten days later; so that there would be nearly three weeks between the

Early and Late Argenteuil. Among the ordinary varieties, however, there is only a short period between the earliest and the latest.

In the present condition of market gardening, and because of the means of transportation now at the command of most growers, earliness is not so important a feature as it would be were all cities and towns supplied by their own immediate suburbs. It may, however, be of some advantage to the grower in the far South to have an extra early variety, as these growers are the first in the market, or it might pay a "local" grower to have both early and late, in order to have a long cutting season as well as to get early prices, if his market depends entirely on local supplies; but as the season for asparagus in more northern localities approaches there is no peculiar advantage to be gained from an early variety, as the "edge is already off the market," and the very early asparagus not only runs the risk of a belated frost, but may strike market when the supply from the more southern growers is in greatest abundance and the price somewhat depressed.

The forcer of asparagus under glass, etc., has been able to supply the demand for high-priced asparagus in our large cities, though of course at an expense much greater than that which the outdoor grower incurs; so, all things considered, it is really the medium early but prolific bearer of larger spears which comes nearer to the requirements of even the average Southern grower. Canned asparagus, too, is on the market all during the winter season, and as the product of the cannery more nearly resembles the fresh article than most canned vegetables the demand for it is very good.

There are large areas of asparagus whose growers contract to deliver all their product to the cannery at a fixed price per bunch, and for these growers the early variety has no attractions, unless all growers plant it, as the cannery only begins operations at a time when experience has shown that asparagus may be expected to be had in considerable quantities.

From early in March until July outdoor-grown asparagus is on the market, the earliest coming from our Southeastern seacoast and the latest from New England and northwestern New York, with the different intermediate localities sending in their quota some time during this period.

Six weeks from date of beginning to cut, or perhaps, if the bed is very vigorous, eight weeks therefrom, one should cease cutting and permit the succeeding shoots to develop, that the roots may have a chance to recuperate for the next season's crop. Young beds, however, are not cut for market until the second spring after having been set out, and then only a light harvest should be made, lasting perhaps



FIG. 3.—Knife for cutting asparagus.

three weeks, as the roots will not stand a full harvest of six or eight weeks before they are five years old without suffering permanent injury.

If green asparagus is desired, the stalks need be cut only so far beneath the surface as to furnish a 9 or 10 inch spear, the major part of which, say 6 inches or more, will be green, and of course above ground. If white asparagus is sought for, the rows will have been ridged from 10 to 15 inches above the crowns, and the spears must be cut as soon as they show at, and before they peep above, the surface. This means cutting 9 or 10 inches below the surface. To accomplish this, long chisellike knives of various shapes are used, the most common kind in use being shown in fig. 3. These knives are from 12 to 15 inches long, and the cutting edge is on the end.

Cutting should be done at least every day, and when vegetation is rapid twich each day will be necessary for white asparagus, and is often desirable when the green sort is being cut.

In many European beds a knife is never used, the following being the method used:

The slightly hardened crust around the emerging bud is pushed aside. The fore and middle fingers, separate, are then pushed deeply into the soft mound, pushing the earth outward. If a rising shoot be met with on the way down, it is carefully avoided. A second plunge of the two fingers and pushing out of the earth usually bring them to the hardened ground about the crest of the root. The forefinger is then slipped behind the base of the shoot and pushed gently outward, when the shoot at once snaps clean off at its base. This plan has the advantage of leaving no mutilated shoots or decaying matter in the ground. The earth is loosely and gently raked up with the hand, so as to leave the surface of the mound (ridge) as it was before, care being taken not to press the earth in any way, but to keep it quite friable. The shoots are not rubbed or cleaned in any way. It would disfigure them, and they do not need it.

In this country the cutting is usually done by men, who, passing along between the rows, carefully cut all discoverable spears, if white asparagus is being put up, or, if green, all those which are in proper condition and which by cutting 2 or 3 inches below the surface will be long enough for market.

The manner of cutting is to take hold of the end of the spear with the left hand, insert the knife to the desired depth, carefully avoiding other spears, and sever the spear if possible with one downward stroke, at the same time drawing out the severed spear and dropping it into a basket carried for that purpose. An active farm hand, after a little practice, should be able to cut several hundred bunches per day.

The spears are sorted into extras, primes, and seconds, ranging from 10 to 50 spears to the bunch, there being no difference in the diameter, but considerable in weight of the bunches. Of course the large, fine spears sell highest, but to the cultivated taste the moderate-sized but tender spears found in primes are preferable.

The bunching is done in the barn or in a shed, and the operators are

usually women. Patent bunchers (fig. 4) are used, each holding tightly a bunch of the proper size while it is being tied at each end with jute twine or sisal grass, so that it will retain its shape. The spears are placed with the heads all one way, and the butts are cut off evenly with a sharp knife. Some skill is needed to put up bunches rapidly;

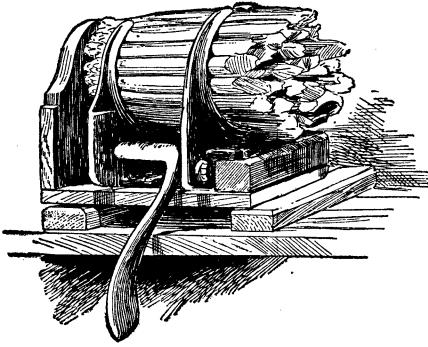


FIG. 4.—Asparagus buncher and bunch of spears ready to be tied.

but it is work that can be done by anyone, the only requisite being to so arrange the spears that the bunch shall present a good appearance and the spears be somewhat uniform in size.

Packing for shipment is frequently done very carelessly, and all kinds of nondescript packages are to be found in market. This may not entail serious loss in the case of nearby shippers or of those who take their asparagus to market in wagons; but to ship

to market in any but the best and most carefully put up package is to sacrifice a price which sometimes amounts to all the profit. The writer has seen asparagus in the market packed in soap boxes, strawberry crates, solid and slatted crates built to hold several dozens, and the bunches placed on their sides, on end, one on top of the other, etc.—any way to get them in.

Perhaps the crate known as the Southern package is as good as any for shipping. These are built to hold from 2 to 3 dozen bunches set on the big end on moist moss to preserve their freshness.

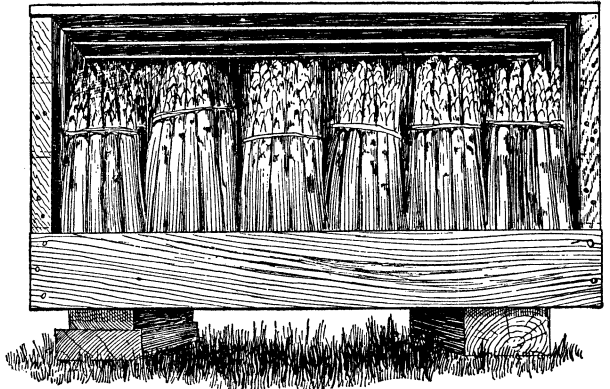


FIG. 5.—Box containing 24 bunches of green asparagus.

The box holding 30 bunches, $4\frac{1}{2}$ inches in diameter, is of the following dimensions: Twenty-eight inches long, 22 inches wide, and 9 inches deep, outside measurement. It is made as follows: Ends $\frac{7}{8}$ inch thick, slats $\frac{3}{8}$ inch by $4\frac{1}{2}$ inches wide, and the cost is about \$12.50 per hundred boxes. The box holding 2 dozen bunches of green asparagus, shown in fig. 5, all ready for shipment, with the exception of 3 slats still to be nailed on, is of the following dimensions: Twenty-four by 17 inches by 12

inches, and the top is some 3 inches narrower than the bottom, thus holding the bunches more firmly, as they, being smaller at the top, are often shaken about and bruised in the straight-sided boxes. These are made of different heights to accommodate long or short bunches, but as there is often a premium, sometimes equal to all expenses of shipping, on long bunches, it is wise to provide for full-length bunches, especially when shipping green asparagus. Figs. 6 and 7 show 2 long bunches of green asparagus (side and end views), 1 bunch containing 11 spears and weighing $2\frac{1}{2}$ pounds, and the other 25 spears and weighing 3 pounds. The first is an "extra" and the other a "prime."

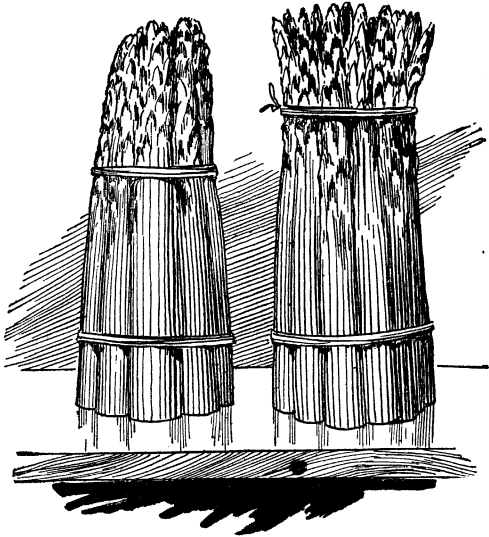


FIG. 6.—Two bunches of green asparagus (10 inches long, with 11 and 25 spears, respectively).

Figs. 8 and 9 show four bunches of white asparagus cut for a cannery on Long Island, and classed as primes. The box on which they stand is 14 inches wide and the bunches $8\frac{1}{2}$ inches long.

When shipped long distances these packages should go by express, as the time even fast freight consumes will prove injurious to asparagus.

Bunches which have to be kept for a day or more, or even over night, should either be packed in sand in a cool cellar or set with their butt ends in shallow (1 inch deep) pans of water.

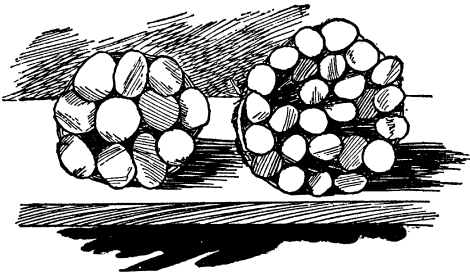


FIG. 7.—End view of the two bunches of green asparagus shown in fig. 6.

The yield per acre and price per bunch have a decided effect upon the profit and loss point of view. The cannery who this year (1897) paid 10 cents a bunch for prime asparagus or 4 cents for culls paid

prices which satisfied growers, although in the city markets prices were somewhat higher than usual, as the cool spring made the crop late even if it did not lessen the yield. The contractors, of course, took all asparagus offered, and the growers found it more profitable than shipping to city markets.

By planting a late variety such as Late Purple Argenteuil, which, while not much later in appearing in the spring, bears much longer than the early varieties, or by treatment inducing a second growth during the summer (which is, however, rather exhausting to the crowns), naturally grown asparagus can be produced for market until midsummer.

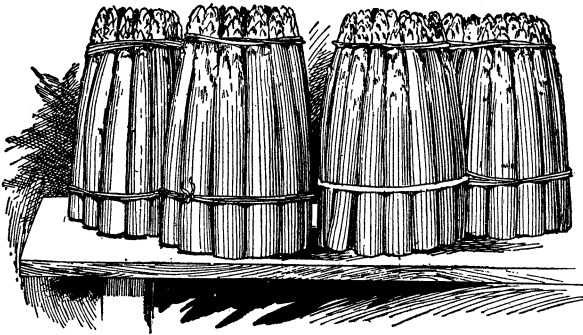


FIG. 8.—Four bunches prime white asparagus ($8\frac{1}{4}$ inches long, averaging 30 spears to the bunch, weight 2 pounds).

In addition to this, by forcing the beds or the roots removed from the beds to hothouses, asparagus can be supplied continuously from December until early spring, when the open beds begin again to produce.

In Europe, owing to the trend of

the country, the season of fresh asparagus is much shorter than in this country, and for that reason, perhaps, forcing has been more widely practiced.

The London market has been a great consumer of the forced article, and the local market gardeners are largely engaged in supplying the demand. But this business is by no means more extensively followed by the London than by the continental gardeners. As an example of the extensiveness of this industry in France, reference is made to one farm at Saint-Ouen, on which 67 acres are devoted to growing asparagus crowns to be forced for the winter market, and there are numerous growers engaged in supplying the Paris demand for hothouse asparagus. This industry is also extensively carried on near the large cities of the United States, among which Boston is perhaps the best market for forced asparagus.

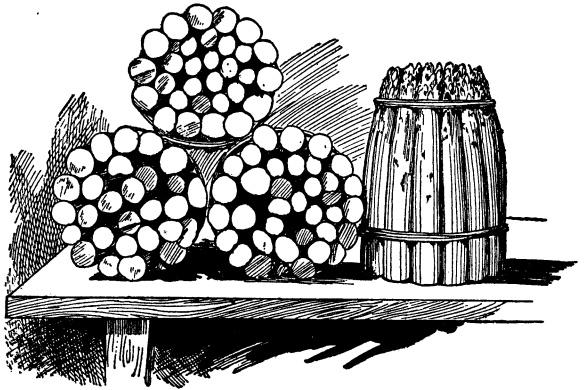


FIG. 9.—End view of three of the four bunches of prime white asparagus shown in fig. 8.

CANNING AND DRYING.

The preserving of asparagus for use at a time when fresh asparagus is not available has been practiced many years by thrifty housewives both in Europe and in this country.

CANNING.

It is not in the province of this bulletin to attempt a description of asparagus canning as practiced in a factory; for such at best would be the detailing of the method practiced at one and might differ widely from the practice of every other, and besides it is a business requiring expert knowledge and considerable capital, while domestic canning of asparagus is as simple as for any fruit or other vegetable.

In Austria, Germany, Sweden, and France canned asparagus is a frequent dish. In England "tinned" asparagus seems not to have gained a foothold, although it is not unknown, and California and Long Island "tinned" asparagus are receiving favorable recognition in London.

A lady of experience as a housekeeper gives the following recipe:

Cut the asparagus the length of a fruit jar, pack the jar closely, fill with cold water, add a little salt, and put the lid on loosely. Place these jars in hot water reaching to the brim, and boil for three hours, adding enough hot water to that in the jars to keep them full. Close lids tightly and set jars away to cool.

Of course the tough outer scale should be removed and the spears carefully washed prior to being placed in the jars; the butt ends should all be placed down, and there should be as little space as possible left at the top. Two hours may be long enough to boil the asparagus, but less than that would scarcely be a full substitute for the several steam baths to which asparagus is subjected in canneries.

Many growers collect the spears broken by the harrow used in leveling off the beds after the cutting season and, putting these with the proceeds of the last cutting, have them canned by the factory for home use, the factory charging them only the actual cost of doing the work. The last day of the season is at most canneries devoted to this kind of work for their patrons. In this way, at a trifling cost, an excellent vegetable is provided for the table during the winter.

To prepare the contents of the can for table, be it home or factory filled, open carefully, pour off the liquid, and either place the asparagus in boiling water for a few minutes (it has already been cooked and only needs to be heated) or set the open can in boiling water until ready to serve on the table, when it is placed on a dish and the desired dressing is added.

DRYING.

For drying, the medium-sized spears are probably, all things considered, the best (although even the small spears may be used for flavoring soups and sauces), but if thoroughly dried so that they will keep,

the large thick stalks are delicious for the table. Perhaps it would be an equitable division to can the largest and dry the others.

In drying use a large needle and strong thread (small twine will do). Pass the thread through the butt end of each stalk, forming a string of a size convenient for handling; this string of stalks is then hung along the exposed side of the house in the full light of the sun. In case the string is not completely dried during the day it is removed to a dry room at night; the next day it is returned to its place in the sunlight

until fully dried. It is then put away in a bag of some porous material, in a dry place, until needed.

When desired for use take a sufficient number of the dried stalks and place them in water which, while not boiling, is very near the boiling point, keeping them there until they resume their succulent, smooth, fresh appearance. To keep the water just right a double boiler is best, with the stalks in the inner one. The water in the outer vessel should be kept at a steady boil.

As the stalks resume the fresh appearance, take them out carefully one by one and place in cold water until cooled, after which place on a dish to dry. They should be carefully scaled to remove the hard outside skin, done up in a bundle

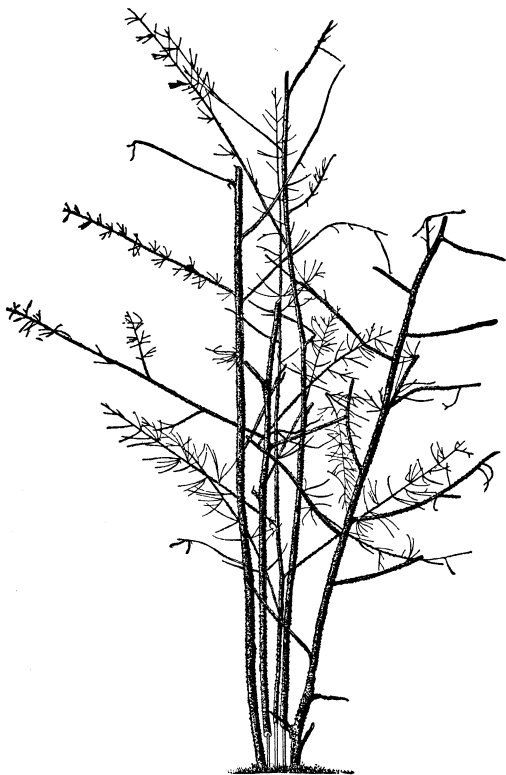


FIG 10.—Stems of asparagus affected with "rust," caused by the fungus *Puccinia asparagi* DC., in which the black sori are seen occupying lines and patches on the stems. (Redrawn and reduced; from Twentieth Annual Report Connecticut State Agricultural Experiment Station.)

either by tying with strings or wrapping in a piece of netting, placed in boiling water, to which a little salt has been added, and allowed to remain there a few moments, a very few, for it cooks quickly, until done.

FUNGUS DISEASES.

Asparagus is subject to the attacks of a number of fungi, the most widespread and destructive being the rust, a fungus long known in Europe, but only recently observed here. In 1896 it caused serious

injury in parts of New Jersey and Long Island and was made the subject of study by Dr. B. D. Halsted.

When the plants are apparently in vigorous growth and full vegetation, they are attacked by this disease (*Puccinia asparagi* DC.), which appears first as small reddish-yellow points on the main stem near the ground and also on the branches and leaves, then, spreading and extending into patches and streaks, it covers the whole plant, turning at the same time to a red-brown or orange color, which later in the season becomes dark colored, and in this form it passes the winter.

As a result of the attacks of the spores the leaves fall, and the plants

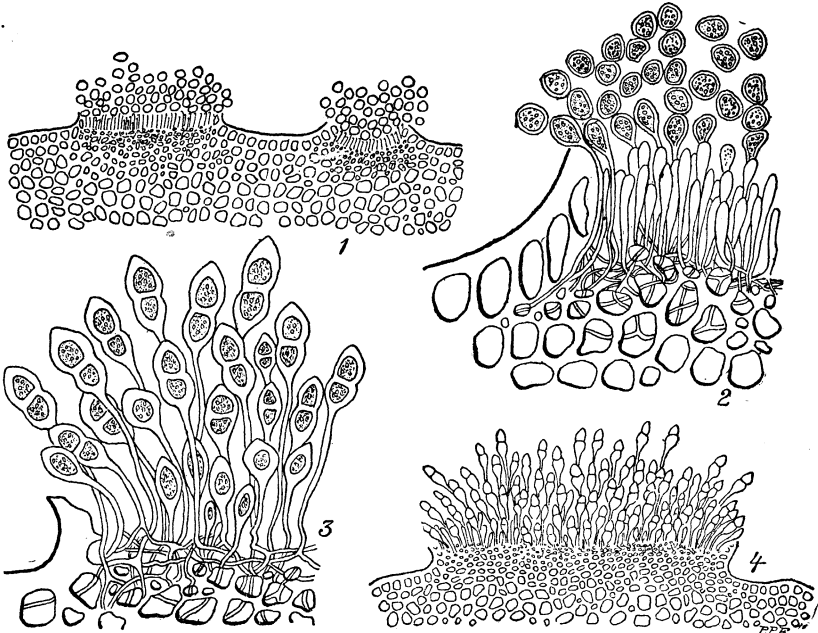


FIG. 11.—Magnified spores of *Puccinia asparagi* DC.: 1, two sori of summer spores, occupying the external tissues of an asparagus stem, magnified 50 diameters; 2, portion of the same, magnified 196 diameters; 3, portion of a sorus of winter spores, magnified 196 diameters; 4, a sorus of winter spores, magnified 50 diameters. (Redrawn; from Twentieth Annual Report Connecticut State Agricultural Experiment Station.)

present a naked appearance (fig. 10). The stalks and branches are rough to the touch, granular, and furrowed. Rust attacks asparagus plants of all ages, from the seedling in the seed bed to the almost exhausted bed of many years' standing. Neither location of the bed in high or low land nor methods of cultivation seem to affect the disease to any great extent.

The earlier or later appearance of the rust is somewhat dependent upon the condition of the weather. At the beginning of a long-continued drought in July or August the rust will make its appearance, and in high, dry locations the ill effects will be more noticeable than in lower lands.

This disease is as enduring as it is dangerous to asparagus culture. It is often two or three years after an attack before the plants entirely recover. The most effectual means of controlling the disease has been by means of fire. The cutting, careful collection, and immediate burning not only of all visibly affected stalks, but of all asparagus brush, both cultivated and wild, early in the autumn are duties that each asparagus grower owes to himself and to every other grower.

In order to prevent the crowns from becoming infected the ground should be kept light and open by frequent hoeings and cultivation, and during the winter the soil should be kept free from all standing water. Extreme dampness will, without doubt, induce root decay, and that is a

favorable condition for developing the disease.

Perhaps the withholding of organic manures and substituting chemical fertilizers may assist in preventing the disease; or the addition of sand and charcoal or coal ashes will aid in keeping the plants healthy and in absorbing the overabundant winter moisture.

Spraying may do something toward checking the disease, and some standard fungicide, like Bordeaux mixture with paris green added, should be used after the cutting season is over and as soon as the foliage begins to develop; for, while

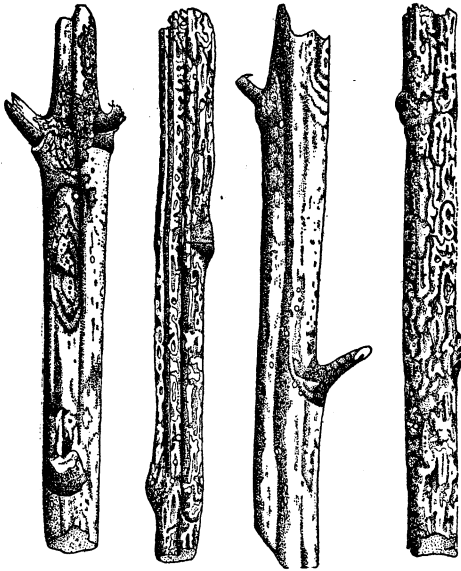


FIG. 12.—Portion of rusted asparagus stems. (Redrawn; from Report, 1896, New Jersey Agricultural Experiment Stations.)

this fungus is one which does not readily yield to treatment, some good may be accomplished, and the arsenite used will at least make the plants unwholesome food for the beetles and their larvæ.

Professor Halsted says in a circular concerning the asparagus rust, issued September 18, 1896:

When an asparagus field is badly infected with the rust, the general appearance is that of an unseasonable maturing of the plants. Instead of the usual healthy green color, the field has a brownish hue, as if insects had sapped the plants or frosts had destroyed the vitality. Rusted asparagus plants, when viewed closely, are found to have the skin of the stems, both large and small, lifted as if blistered, and in the ruptures of the epidermis dark-brown spots are readily seen. These brown dots or lines are of various sizes and shapes, and remind the close observer of similar spots in the broken skin of stems of grains and grasses and of the leaves of corn attacked by rust, but not the same kind as that of asparagus.

The asparagus rust is due to fungus; that is, a minute plant (fig. 11), consisting of

microscopic threads which grow through the substance of the asparagus plant, taking up the nourishment that is needed (by the plant itself) and finally breaking through the surface to bear the innumerable brown spores that give the dark-brown color to the spots on the asparagus skins. This is the last stage in the development of the rust fungus, and as such it remains over winter. When the warm, moist weather of spring and summer comes, the spores above mentioned germinate, and a new lot of asparagus plants may become infected.

In the Botanist Report of the New Jersey Experiment Stations for 1896, Professor Halsted has, among other remarks, this to say about the asparagus rust attack of that year:

The writer has never met with any species of rust that was so overwhelming in its attack. Fields, for example, of a dozen acres would not have a plant, and scarcely a square inch of surface, free from the pustules. It attacks all ages of plants, but

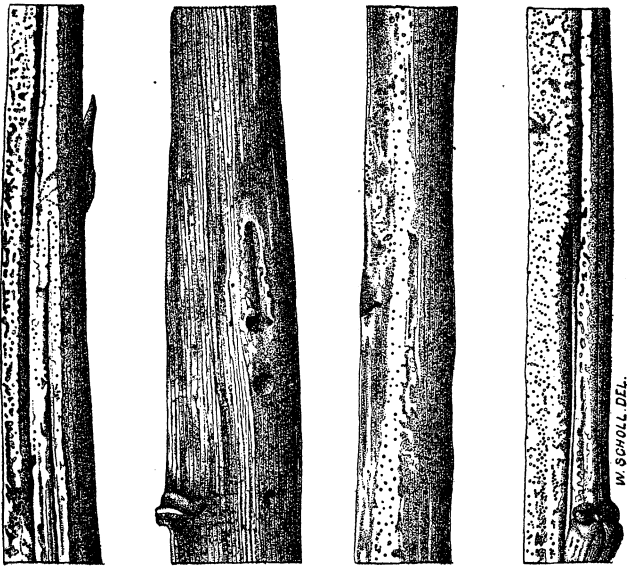


FIG. 13.—The asparagus anthracnose (*Colletotrichum* sp.). (Redrawn; from Report, 1896, New Jersey Agricultural Experiment Stations.)

the older beds turned brown first, and the last to lose their usual green color were the seedlings. The brush is reduced to the main stems, the finer portions having become thoroughly affected and fallen away. Portions of stems of older plants are shown in fig. 12, where the rifts in the skin may be seen and the spore masses appear as dark blotches.

All varieties of asparagus grown in this country seem to be readily affected by the rust, the Palmetto being less susceptible than any others. Professor Halsted places it at 60 on a basis of 100. Claim is also made by European growers that the Yellow Burgundy is almost rust proof.

The rust has been reported from New England generally, Long Island, New Jersey, Delaware, Maryland, the District of Columbia, Iowa, Indiana, Ohio, and South Carolina. From the interest taken in the

subject by the growers, who are promptly adopting the suggestions made as to burning, etc., it is doubtless true that had it been elsewhere in any quantity reports of its presence would have been made.

According to Massachusetts Hatchery Experiment Station Report, 1899, p. 61, there appears to be a relationship between the water-retaining properties of the soil and the occurrence of rust, the disease being most prevalent upon light sandy soils. Spraying the plants with Bordeaux mixture has been tried with some apparent success in controlling the disease, and in New York Station Bulletin 188 spraying with Bordeaux mixture to which has been added 5 pounds resin, 1 pound potash lye, 1 pound fish oil, and five gallons water is recommended. A number of parasitic fungi are known to attack the asparagus rust and aid materially in keeping it in check.

Other diseases due to fungi are known to attack asparagus plants, among which an anthracnose (*Colletotrichum* sp.) is by no means insignificant, and its effect upon the stalk of asparagus consists of multitudes of minute dark specks, shown in fig. 13. In Europe a fungus, known as *Sclerotium durum* Pers, attacks the old stalks, and another, known as *Cereospora asparagi* Saccardo, forms gray specks on the green branches of asparagus; still another, the copper-red thread fungus, attacks the roots, and is familiarly known as the "root killer."

INSECT ENEMIES.

By F. H. CHITTENDEN, *Assistant Entomologist.*

The principal insect enemies of asparagus are two beetles, both imported from the Old World, and both, so far as known, limited for food supply to this plant. A third insect, known as the asparagus fly (*Platyparea pœciloptera* Schrk.), is also injurious to asparagus in Europe, but it has not yet been detected in this country, and is only mentioned that American asparagus growers may be on their guard against it, as it is a species that is liable at any time to be brought to our shores.

THE COMMON ASPARAGUS BEETLE.

(*Crioceris asparagi* Linn.)

This species, as its common name indicates, is still the most abundant of the asparagus beetles and by far the most important enemy of this plant. Its first appearance was noted in this country at Astoria, near New York City, in 1860, and it is now conceded that it was introduced into that locality about 1856.

The injury inflicted by this insect is due to the work of both adults and larvæ upon the tender shoots, which they render unfit for market early in the season. Later they destroy by defoliation growing plants, and are particularly injurious to seedlings, the roots of which are weakened by having their tops devoured. Larvæ, as well as beetles, attack the tenderest portions of the plants, but the latter gnaw with seemingly equal relish the epidermis or rind of the stems. The beetles

are also accused of gnawing young shoots beneath the surface, causing them to become woody and crooked in growth.

The beetle illustrated by fig. 14 is a most beautiful creature, slender and graceful in form, blue-black in color, with red thorax, and lemon-yellow and dark-blue elytra or wing covers, with reddish border. Its length is a trifle less than one-fourth of an inch.

From the scene of its first colonization in Queens County the insect migrated to the other truck-growing portions of Long Island. It soon reached southern Connecticut, and has now extended its range northward through that State and Massachusetts to the State line of New Hampshire. Southward it has traveled through New Jersey, where it was first noticed in 1868, to southern Virginia. At the present time it is known to be well established in the principal asparagus-growing sections of Massachusetts, Connecticut, New Jersey, Delaware, and Maryland. In Pennsylvania it is present in the southeastern portion of the State near the Delaware River, and in Virginia it extends southward along the banks of the Potomac. In New York State it occupies,

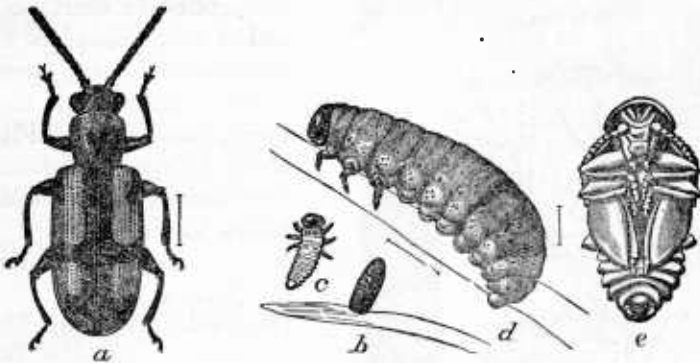


FIG. 14.—Common asparagus beetle: *a*, beetle; *b*, egg; *c*, newly hatched larva; *d*, full-grown larva; *e*, pupa—all enlarged (from Chittenden, Yearbook of U. S. Department of Agriculture, 1896).

besides Long Island, a narrow strip along the Hudson to a point about 20 miles north of Albany, and it has very recently made its appearance in four counties in the northwestern section of the State. In Ohio it has found its way to four counties between Cleveland and the Pennsylvania State line.

The question of distribution is an important one, as this species is rapidly extending its range. In a very few years we may expect its spread to other portions of the States in which it is now local, and later it will naturally move westward to Indiana and other States west and south of there.

The insect passes the winter in the beetle state under convenient shelter, and toward the end of April or early in May, according to locality, or at the season for cutting the asparagus for market, issues from its hibernating quarters and lays its eggs for the first brood. The eggs are deposited endwise upon the stem or foliage and in early spring on the developing stalks, usually in rows of from two to six or more.

In from three to eight days the eggs hatch, the young larvæ, commonly called "grubs" or "worms," presenting the appearance indicated in fig. 14, *c*. They at once begin to feed, and are from ten days to a fortnight, according to Fitch and others, in attaining full growth. When full grown the larva appears as in fig. 14, *d*. It is soft and fleshy, much wrinkled, and in color is dark gray or olive, which usually becomes lighter and yellowish with age. The mature larva enters the



FIG. 15.—Spray of asparagus, with common asparagus beetle in its different stages; asparagus top at right, showing eggs and injury—natural size (from Chittenden, Yearbook of U. S. Department of Agriculture, 1896).

earth, and here, within a little rounded, dirt-covered cocoon which it forms, the pupa state is assumed. The pupa is yellowish in color and its appearance is sufficiently shown by the illustration (fig. 14, *e*.) In from five to eight or more days the adult beetle is produced, which soon issues from the ground in search of food and of a suitable place for the continuance of the species.

The duration of the life cycle, according to Fitch, is about thirty days from the time the egg is laid until the insect attains maturity, but the time is shorter in the hotter parts of a season than in the cooler days of May or September. In the District of Columbia the eggs, in the warmest part of midsummer, develop in three days and the pupæ in five days. From this it may be estimated that, in the very warmest weather, the development of the insect may be effected in about three

weeks from the time the egg is laid. In colder climates and in spring and autumn the development from egg to beetle will require from four to perhaps seven weeks. In the northern range of the species two and perhaps three broods are usually produced, and farther southward there is a possibility of at least a fourth generation. In the latitude of the District of Columbia the beetles usually disappear to enter into hibernation in the latter days of September.

The common asparagus beetle has very efficient checks in the shape of predaceous insects, which prey upon its larvæ and assist in

preventing its undue increase. One of the most active of these predaceous insects is the spotted ladybird (*Megilla maculata* DeG.), represented in its several stages in the illustration (fig. 16). The adult of this beetle is rose colored, with numerous black spots. The spined soldier bug (*Podisus spinosus* Dall.) and the bordered soldier bug (*Stiretrus anchorago* Fab.) are also useful as destroyers of asparagus-beetle larvæ, which they catch and kill by impaling them upon their long beaks and sucking out their juices. Certain species of wasps and small dragon flies also prey upon the larvæ.

Asparagus beetles are very susceptible to sudden changes of temperature, and immense numbers of hibernating beetles are sometimes killed in winter during severe cold spells following "open" weather.

Remedies.—The common asparagus beetle, under ordinary circumstances, may be held in restraint by the simplest means.

Chickens and ducks are efficient destroyers of the insect, and their services are often brought into requisition for this purpose.

A practice that is in high favor among prominent asparagus growers is to cut down all plants, including volunteer growth, in early spring to force the beetles to deposit their eggs upon new shoots, which are then cut every few days before the eggs have time to hatch. Another measure of value consists in permitting a portion of the shoots to grow and serve as lures for the beetles. Here they may be killed with insecticides, or the plants after they become covered with eggs may be cut down and burned, and other shoots be allowed to grow up as decoys.

One of the best remedies against the larvæ is fresh, air-slaked lime dusted on the plants in the early morning while the dew is on. It quickly destroys all the grubs with which it comes in contact.

The arsenites, applied dry in powder mixed with flour, answer equally well, and they possess the advantage of destroying beetles as well as grubs, and are of value upon plants that are not being cut for food. Some of our correspondents use a mixture of paris green and air-slaked lime, or plaster, 2 pounds of the former to a barrel of the latter. It should be borne in mind that to produce satisfactory results the lime or arsenite must be applied at frequent intervals, or as often as the larvæ reappear on the beds.

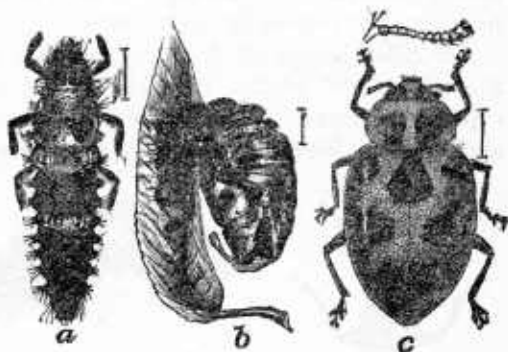


FIG. 16.—Spotted ladybird; a, larva; b, empty pupal skin; c, beetle with enlarged antenna above—all enlarged (from Chittenden, Yearbook U. S. Department of Agriculture 1896).

A simple method of killing the larvæ in hot weather is to beat or brush them from the plants with a stick so that they will drop to the heated earth, where they die, being unable to regain the shelter of the plants.

With concerted action in following out any of these methods the insects may be held in check, at least in regions where asparagus does not grow wild in too great profusion.

THE TWELVE-SPOTTED ASPARAGUS BEETLE.

(*Crioceris 12-punctata* Linn.)

The presence of this insect in America was first detected in 1881, and it is still much rarer and consequently less injurious than the preceding species. In Europe, where it is apparently native, it is common, but not especially destructive.

The chief source of damage from this species is from the work of the hibernated beetles in early spring upon the young and edible asparagus shoots. Later beetles, as well as larvæ, appear to feed exclusively on the berries. The eggs are deposited singly, and, apparently

by preference, upon old plants toward the ends of shoots, which, lower down, bear ripening berries, and they are attached along their sides instead of at one end, as is the case with the eggs of the common species. Soon after the larva hatches from the egg it finds its way to an asparagus berry, enters it, and feeds upon the pulp. In due time it leaves this first berry for another one, and when full growth is

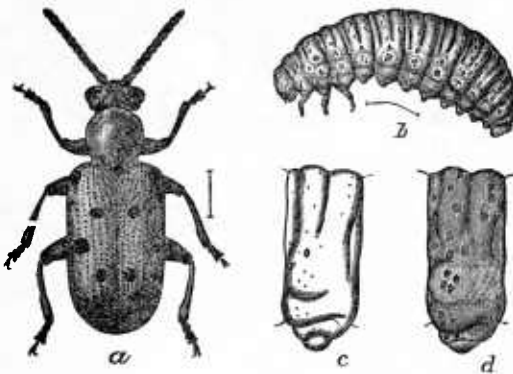


FIG. 17.—Twelve-spotted asparagus beetle: a, beetle; b, larva; c, second abdominal segment of larva; d, same of common asparagus beetle—a, b, enlarged, c, d, more enlarged (from Chittenden, Yearbook U. S. Department of Agriculture, 1896).

attained it deserts its last larval habitation and enters the earth, where it transforms to pupa and afterwards to the adult beetle. The life cycle does not differ materially from that of the common species, and there are probably the same or nearly as many generations developed.

This species is at present distributed throughout the asparagus-growing country in the southern two-thirds of New Jersey, particularly in the vicinity of the Delaware River; the whole of Delaware, nearly the entire State of Maryland, the District of Columbia, the southeastern portion of Pennsylvania bordering the State line of New Jersey, and

northeastern Virginia in the vicinity of the western shore of the Potomac River. During recent years it has been reported in Monmouth County, N. J., Staten Island and Monroe County, N. Y., the last mentioned being the most northern locality known for the species.

The mature beetle in life rivals the common asparagus beetle in beauty, but may be distinguished by its much broader wing covers and its color. The ground color is orange red, each wing cover is marked with six black dots, and the knees and a portion of the under surface of the thorax are also marked with black (see fig. 17, *a*). The beetle as it occurs on the plant when in fruit very closely resembles, at a little distance, a ripe asparagus berry.

The full-grown larva is shown in the illustration at fig. 17, *b*. It measures, when extended, three-tenths of an inch, being of about the same proportions as the larva of the common species, but is readily separable by its ochraceous orange color.

Remedies.—The remedies are those indicated for the common asparagus beetle, with the possible exception of caustic lime and other measures that are directed solely against that species, but the habit of the larva of living within the berry places it for that period beyond the reach of insecticides. The collection and destruction of the asparagus berries before ripening might be a solution of the problem, but it is questionable if recourse to this measure would be necessary, save in case of an exceptional abundance of the insect.

A more complete report on insects affecting asparagus is in preparation, and will be published in the near future in a farmer's bulletin by F. H. Chittenden, Assistant Entomologist, U. S. Department of Agriculture.

